

STUDIES IN RICKETS*

CLINICAL FINDINGS IN 1,000 PRIVATE PATIENTS

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AND

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RICKETS has been defined as a disorder of nutrition affecting the body as a whole and, in particular, the muscular, nervous, and osseous systems. The chief etiologic factor is now recognized as a deficiency of vitamin D. In man, vitamin D is formed by the action of ultra-violet rays of a certain wave length (260-315 Mu.) upon the lipoids found just beneath the surface of the skin. These lipoids contain the provitamin, ergosterol, which is changed to its isomere, calciferol,² or vitamin D. This vitamin is the catalyzer which causes the two minerals, calcium and phosphorus, to combine chemically as calcium phosphate in the system. Approximately three-fourths of the mineral content of the human body is calcium phosphate.

CALCIUM INTAKE OF PRIMITIVE AND MODERN MAN

Primitive man was created to lead an active outdoor life. It is estimated that he consumed daily two grams of calcium from his 5,000 calories of food. The average adult today consumes approximately only 2,400 calories, or less than half that of his primitive ancestor. Aside from milk, our highly refined diets today furnish a daily average of only 0.17 gram of calcium, or one-sixth the amount required.³ This is an especially serious defect during growth, pregnancy, and lactation. With this great reduction in our calcium intake, our need of vitamin D is correspondingly increased in order that all the calcium ingested may be fully assimilated.

CLIMATE AND MODE OF LIVING AS CAUSATIVE FACTORS

The climatic conditions of the temperate zones and our highly civilized manner of life also favor the development of rickets. The full effect of ultra-violet rays cannot be obtained through the thinnest of clothing or even ordinary glass. Neither can these rays pass through the pall of haze, mist, fog, smoke, or dust which hangs so constantly over large areas of city and countryside.⁴ These factors decrease the natural activation of ergosterol into vitamin D.

All of the other vitamins are found in adequate amounts in the average diet; but vitamin D is limited. Our common foods, with the exception of egg yolk, and to a variable and slight degree, butter, cream and milk, contain practically none of it. Vegetables, fruits, meats, and cereals are all lacking in this factor. Cod-liver oil, of course, is rich in vitamin D. The use of this and other

medicinal antirachitics have reduced the frequency of severe types of rickets, such as are readily recognizable by the laity. But how frequently does mild rickets occur? We are asked to prescribe antirachitics without first determining the need through local surveys. Hess⁵ believed that no other disease of childhood is so commonly overlooked.

ANALYSIS OF ONE THOUSAND CONSECUTIVE CASES

With this idea in mind the determination of the prevalence of rickets in our own locality was thought to be of interest. For this purpose the records of one thousand consecutive cases, examined in recent years, were reviewed to ascertain the frequency of clinical signs of rickets. Since these children were brought to the office for various reasons, the examination of the bony structure in many of them was only incidental. It is quite probable, therefore, that the frequency of the various signs is understated rather than overstated. That the parents were health conscious is indicated by the fact that approximately 40 per cent of the examinations were "health examinations" in well children. The majority in this series had been given from birth such antirachitics as were available at the time. These measures must have reduced the number and severity of rachitic manifestations in this group below that of the child population of the city at large.

GROUP CLASSIFICATION BY AGE

For purposes of comparison the cases were divided into four groups according to age. The first group contains 226 infants, six months of age or under; the second group, including children from six months to two years of age, numbers 403; the preschool group (two to six years), 329; and the school-age group (six to sixteen), 248. Some of the children are included in more than one group because they were followed for several years; hence the sum of the groups is greater than the total number of children studied.

OSSEOUS SIGNS OF RICKETS

Some controversy has existed as to what osseous signs are necessary for a diagnosis of rickets. All of the signs included in this study, with the exception of the newer one, costomalacia,¹ are considered rachitic by such authors as Hess,⁵ Holt,⁶ Abt,⁷ Griffith and Mitchell,⁸ and others. These signs include for the head: bossing craniotabes, large anterior fontanelles (over three cubic centimeters), palpable mastoid or sagittal fontanelles and certain abnormal head shapes—flat or quadratic; for the chest such deformities as: Harrison's groove, beading, anterior softening (costomalacia), and square, funnel, or pigeon breast; for the extremities: enlarged epiphyses, genu valgum, genu varum, and pronated flatfoot.

The occurrence of the abnormalities noted in the skull were found to reach their highest percentage during the first months of life (Fig. 1). Craniotabes is especially evident during the first six months and reached a very high incidence in comparison with other reports. This is of especial significance because it is one of the earliest

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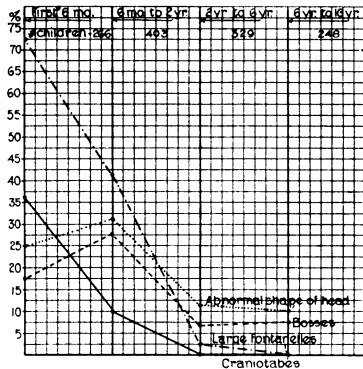


Fig. 1

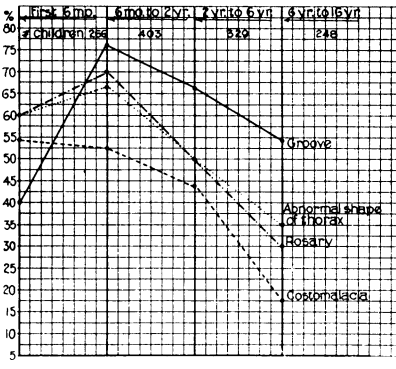


Fig. 2

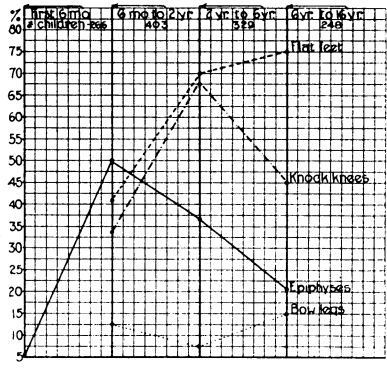


Fig. 3

Fig. 1.—Head signs of rickets by age groups.
Fig. 2.—Percentage frequency of thoracic signs of osseous malnutrition by age groups.
Fig. 3.—Percentage frequency of signs of osseous malnutrition in legs and feet, by age groups.

signs of active rickets. Chest signs, such as abnormal shape, costomalacia, enlarged costochondral junctions and Harrison's groove, are all very frequent in each of the age groups, but reach the highest point between six months and two years (Fig. 2).

After weight is put upon the feet, the changes in the lower extremities, such as bow-legs, knock-knees, and flatfeet, become common, especially the latter two (Fig. 3). These signs reach their highest point during the preschool age and continue at almost that level throughout the period of observation. Griffith and Mitchell⁸ also have found flatfoot a common rachitic deformity. Enlargement of the epiphyses is an earlier change, reaching its high point, 50 per cent, during infancy.

PREFERENTIAL SITES OF DEFORMITIES

Our observations are that the most rapidly growing portion of the skeleton at each age shows the greatest abnormality for that period (Fig. 4). Thus the head, which attains its permanent shape shortly thereafter, shows the most frequent signs of rickets during early infancy. Throughout the first year the chest is making its most rapid growth and, therefore, shows at this time its highest percentage of deformities. These stigmata may per-

sist, however, into the older groups. Changes in the extremities become more marked with time and, according to our records, outnumber all the other signs in children of school age.

This study reveals clinical evidence of osseous malnutrition in 97.6 per cent. In only twenty-four children, or 2.4 per cent of the one thousand histories reviewed, is there no record of bony changes attributable to rickets. An analysis of the signs recorded demonstrates (Fig. 5) that the chest findings, groove, beading and costomalacia are the most frequent. It was found that 91.6 per cent of these children had at least two signs of rickets, and that 75.8 per cent had three or more signs.

CONTRAST WITH OTHER LOCALITIES

Other localities have reported percentages practically as high as these we have found in our Portland records. Incidence studies of rickets made on certain groups of children in Hamburg revealed this dyscrasia in 95 per cent; in Riga, 86 per cent; in Boston, 79 per cent; while in Dresden, autopsies on a group of children two months to four years of age demonstrated rickets in 89 per cent.⁸

In a report on the comparative incidence of rachitic signs in children under three years of

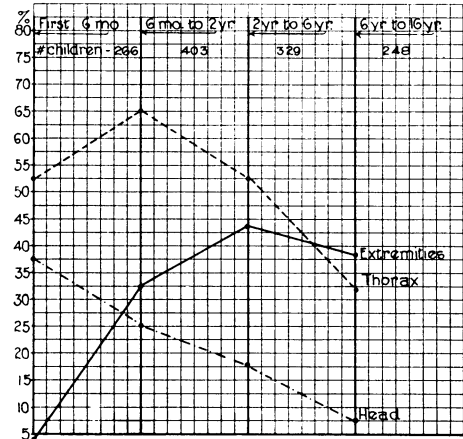


Fig. 4

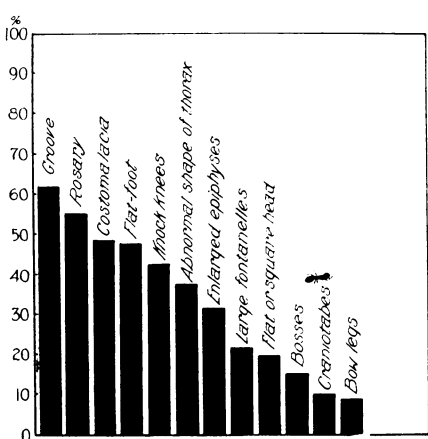


Fig. 5

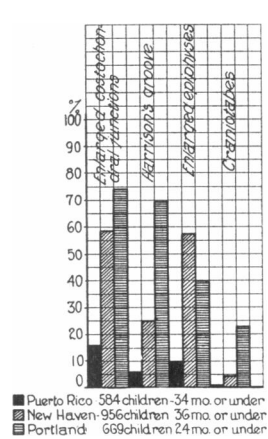


Fig. 6

Fig. 4.—Graph indicating the location of signs of osseous malnutrition in various age groups.
Fig. 5.—Frequency of certain clinical signs of osseous malnutrition in 1,000 children.
Fig. 6.—Comparative frequency of four signs of rickets in widely separated places.

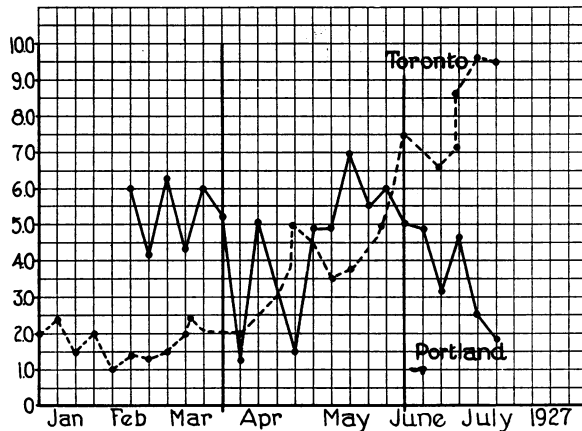


Fig. 7.—Weekly average of ultraviolet light units in the sunshine of Portland, Oregon, and Toronto, Canada (Manville).

age in Porto Rico and New Haven, Eliot⁹ found rosary, groove, and enlarged epiphyses quite characteristic of rickets. Her percentages for these signs and craniotables are compared with ours in Figure 6. It is noteworthy that Portland ranks higher than the other two cities, except as to the epiphyses. Probably we did not examine the wrists with as much care as did Doctor Eliot. Hess^{5, p. 214} states that microscopic examinations of the costochondral junctions usually show signs of rickets and that the common clinical error lay in not considering the beading as large enough to warrant a diagnosis of rickets.

A factor responsible for the amount of rachitic stigmata found in the Portland children is probably meteorologic. Although our climate is mild and equable, there is only a 50 per cent annual average of sunshine. Not only do we have less sunshine than in most other parts of the United States, but its quality is vitiated in the summertime by haze and by smoke from forest fires.¹⁰ Manville has demonstrated that during July, when the ultra-violet radiation should be most intense, it is actually considerably less than in midwinter (Fig. 7). Frawley¹¹ shows that in Fresno, California, "the garden of the sun," the haze which hangs over the valley during the summertime interferes with the transmission of ultra-violet light to such an extent that milk rickets is common even there. Lack of appreciation of these facts causes many parents to omit antirachitic measures in the summertime.

INFLUENCE OF ULTRA-VIOLET LIGHT

The development of a normal skeleton depends not so much on the amount of available ultra-violet light, but rather on the amount that actually reaches the nude skin. This fact is responsible for the presence of rickets, to an extent often not appreciated in even the most favorable climates. Holt well says, "Rickets is perhaps the most common disease of childhood." In sunny Utah, with its clear atmosphere, the marked case of rickets shown in Figure 8 developed. The farm that produced this prize rooster produced also this human specimen of classical rickets, with its square head, large epiphyses, bowed legs, and

flatfeet. Abundance of sunshine may give a false sense of security.

Although, according to present theories, the climate of the Pacific Northwest should produce them, we have never seen in Oregon a severe case of rickets, possibly because the need of anti-rachitics is generally known and applied. However, the common garden variety of mild rickets is evident in most properly taken nude photographs of children (Fig. 9). The correction of these milder deformities early is essential to the development of stronger, sturdier adults. For example, the elimination of flatfoot would increase the economic value of many individuals. A heavy responsibility, therefore, rests upon every physician who examines children.

GREATER HEIGHT FOUND IN WEST COAST NATIVES

Rate of growth is another important factor in the development of rickets. Mankind is growing taller in each succeeding generation, the average gain being three inches in the past four decades. Our army and navy records show that the West Coast produces our country's tallest men. In consequence, the medical profession here is confronted with the problem of strengthening the osseous system in proportion to this increased growth. A sturdy-looking, well-built youth, included in our series of cases, who has now attained a height of six feet two inches, recently fell in his own front yard while whirling on his toe and suffered seven fractures of the tibia. At an earlier age this boy exhibited eight of the

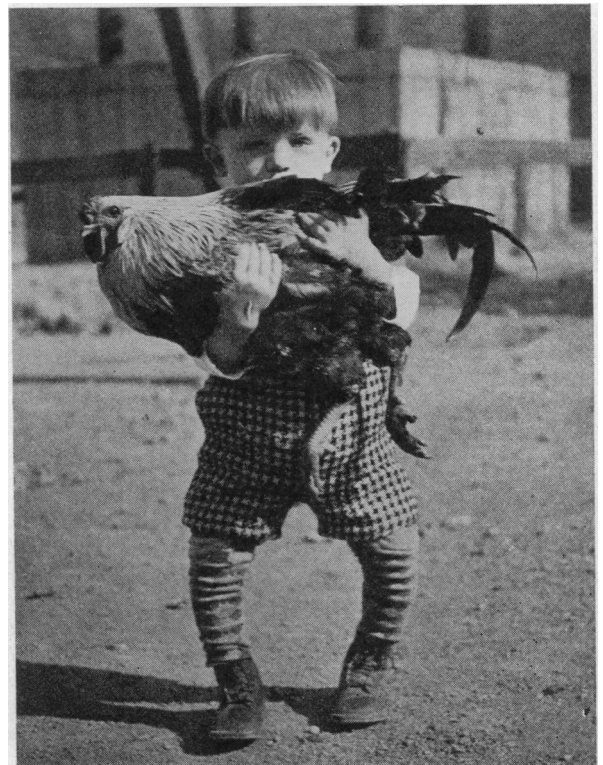


Fig. 8.—Example of severe rickets in a sunny clime with quadratic head, enlarged epiphyses, genu varum, and flat-foot (courtesy E. H. Christopherson, M. D., San Diego).

twelve signs of rickets listed in this study. Is it not probable that the same deficiencies, formerly manifested as rickets, are now appearing as osteoporosis?

PREVENTION

The various antirachitics so far in general use have not been sufficiently effective to prevent entirely osseous malnutrition, even though treatment was begun in the prenatal period. We formerly depended on cod-liver oil, but when three table-spoons daily failed to prevent rickets, we added artificial ultra-violet light, with slightly better results. Later viosterol was also given. That some improvement, however, has resulted from these antirachitic measures is evidenced by the fact that only nine of the 114 cases of craniotabes in this study were seen in the last two years. Doubtless, we can expect further advance toward our goal of perfect skeletal development through the application of additional antirachitic measures. The ideal antirachitic requires little or no maternal cooperation. The recently developed irradiated milk meets this requirement, and is the most reliable and natural preventive of rickets.

Since our living habits interfere with the proper irradiation of ergosterol in the skin, let us compensate for this lack by irradiating a common article of food. Of all of our foods, milk is the richest storehouse of calcium and phosphorus. It also contains some vitamin D, as well as the provitamin which can be changed to vitamin D on short exposure to ultra-violet rays. Thus, in one food are combined the three elements essential to normal bone formation—calcium, phosphorus, and vitamin D.

COMMENTS

A diagnosis of rickets is said by some to be impossible without roentgenograms, and quantitative determinations of the calcium and phosphorus of the blood serum. We recognize the advantage of these laboratory aids in ascertaining accurately the degree of disturbance in acute rickets, and in its differentiation from certain pathologic conditions and endocrine imbalances. We realize also the limited frequency with which such tests can be utilized in mild conditions.

For practical purposes clinical criteria must be adopted. Often, too, when one sees a child for the first time the acute rachitic process is past, but its residua are easily apparent. Photographs in front of a cross-lined screen are valuable for accurate diagnosis and for evidence of improvement. The retaking of such pictures every six months assists in obtaining both patient and parental cooperation in corrective measures.

We, therefore, believe it to be the part of wisdom to accept as signs of rickets those clinical manifestations which have proved acceptable during the past three centuries of scientific study of rickets. One is reminded of A. Graeme Mitchell's remark,¹² "One hardly needs a thermometer to tell him that water is hot when it burns his skin." Degrees of osseous malnutrition, rachitic in type, are palpable to the sensitive hand and visible to the practiced eye. When these defects are pointed out early, before reaching severe degrees, therapeutic

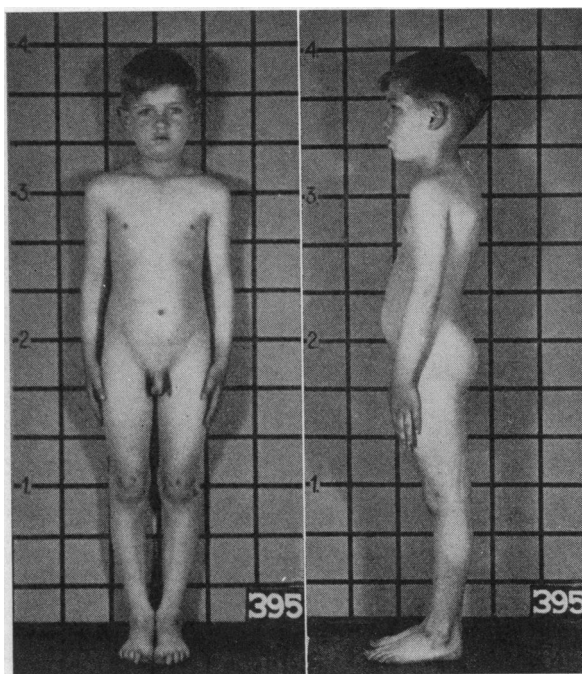


Fig. 9.—Mild rickets indicated by flat chest, bow-legs, and flat feet.

measures are more successful. With younger children a roentgenogram of the wrist assists greatly in determining the need for combining endocrine and antirachitic therapy.

SUMMARY

1. Mild rickets is more common than is generally appreciated.
2. Lack of vitamin D is the most important factor in the etiology of rickets.
3. In man, Vitamin D is formed by the action of ultra-violet light on the lipoids of the skin.
4. Our habits of life prevent sufficient utilization of the available ultra-violet rays by the body.
5. The amount of ultra-violet light available depends on latitude, climate, and atmospheric conditions.
6. Portland, Oregon, has low average annual sunshine and atmospheric conditions which impair its usefulness.
7. At least 97.6 per cent of one thousand private patients examined had one or more clinical signs usually associated with rickets.
8. Of these, the chest signs, beading, groove, and costomalacia were most common.
9. The greatest number of clinical signs were found in the most rapidly growing parts: first the head, then the chest, and later the feet and legs.
10. Under our present dietary and living conditions, the antirachitics so far in general use have been unable to prevent a high percentage of mild rickets. Perhaps the universal use of vitamin D milk will accomplish this.
11. If an improved skeletal development is to be attained in the coming generation, the medical profession and the laity must be awake to the prevalence of bony imperfections and be alert to apply available preventives.

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THE LURE OF MEDICAL HISTORY†

JOSEPH POMEROY WIDNEY, A. M., M. D.,
D. D., LL. D.

FOUNDER OF THE LOS ANGELES COUNTY MEDICAL
ASSOCIATION AND OF THE COLLEGE OF MEDICINE
OF THE UNIVERSITY OF SOUTHERN CALIFORNIA,
CIVIC WORKER AND AUTHOR: SOME BIO-
GRAPHICAL NOTES ON A COLLEAGUE,
WHO, AT THE AGE OF 95, STILL
"CARRIES ON"*

By E. T. W.

PART I

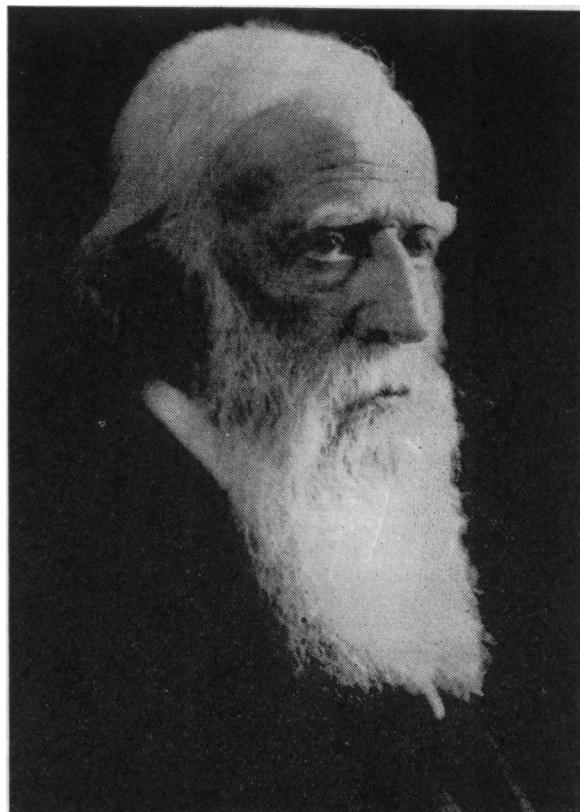
IT is not given to every man, on attaining the ripe old age of four score and fifteen, as has been accorded Dr. Joseph Pomeroy Widney, the veteran physician and distinguished scholar of Los Angeles—who on December 26, 1935, celebrated his ninety-fifth birthday—to look back with modest complacency on a life so well spent and eminently fruitful.

THE DAYS OF YOUTH

Born, in 1841, among the forests of Miami County, Ohio, and in sight—as he himself expresses it—of clusters of Indian wigwams, the son

† A Twenty-five Years Ago column, made up of excerpts from the official journal of the California Medical Association of twenty-five years ago, is printed in each issue of CALIFORNIA AND WESTERN MEDICINE. The column is one of the regular features of the Miscellany department, and its page number will be found on the front cover.

*The Council of the California Medical Association recently authorized the editor to arrange for the sketch presented, the result of a pleasant interview. See also page 251.



JOSEPH POMEROY WIDNEY, A. M., M. D., D. D., LL. D.
Founder of the Los Angeles County Medical Association
and of the College of Medicine of the University of
Southern California.*

of Wilson and Arabella (Maclay) Widney, of sturdy Scotch and Huguenot ancestry, Joseph Widney inherited the very qualities needed to rise out of, and beyond his almost primeval environment. He pursued the required courses of the Piqua high school, and from there entered Miami University at Oxford, Ohio, where his encounter with the academic authorities foreshadowed a mind inclined to think and act for itself. He had read history, he told the president, and had already taught trigonometry, and all that he wanted was more Latin and Greek. He commenced college work as a sophomore, only to leave the classic halls at the end of five months, in voluntary response to a call to arms in defense of his war-torn country.

After shouldering musket and rifle in the field young Widney entered the hospital service on the steamers of the Ohio and the Mississippi. Then, with failing health in the late autumn of 1862, he came to California.

GRADUATION FROM TOLAND MEDICAL COLLEGE
IN 1866

Arriving at San Francisco, he continued the literary courses begun at Miami, in studies pursued at the University of the Pacific, where he was made a Master of Arts; and after that he matriculated in Toland Medical College, later ab-

* This is a photograph of Dr. Joseph P. Widney, taken in the year 1936, and shows his appearance at the age of ninety-five.